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ABSTRACT

This experiment was undertaken to determine whether coincidence-anticipation (intercepting a moving object at a designated point and instant) is facilitated for one side of the body after practice by the other side of the body. This phenomenon is called bilateral transference. Subjects were asked to throw a switch five times with their right (preferred) foot, then 25 times with their (non-preferred) foot, and then five times with the right again. Performance with the left foot indicated that learning had taken place from the prior practice with the right foot. The control group had five trials with the right foot, a ten-minute rest, and five more trials with the right foot. (Tables and references are included.) (CD)

The Effect of Bilateral Transfer on Coincidence-Anticipation Performance

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Introduction

(1) Many psycho-motor skills require participants to accurately intercept a moving object at a designated point and instant. This ability has been termed coincidence-anticipation (C/A) (3). Success or proficiency in implementing this ability is mandatory for successful participation in such activities as batting, soccer, tennis, basketball and numerous others. While the importance of the role of C/A in motor skills performance and acquisition is well accepted by theorists, a review of pertinent literature reveals a paucity of investigations in this area. In studies reported Slater-Hammel (15) investigated accuracy, reliability, and refractoriness as did his student, Belisle (3). Schmidt (13) has examined the role of movement time in timing accuracy; Williams (20), Stadulis (16), and Dunham (5) have studied performance of children. Task specificity and performance of various body segments have been investigated by Grose (7) and Dunham (4).

(2) Given the recognized contribution of the role of C/A in the acquisition and performance of many motor skills, consideration should be directed to the identification of parameters that could possibly facilitate the acquisition of this significant factor.

(3) One possible phenomenon would be bilateral transfer or cross education. Bilaterality refers to the transference of a skill from one side of the body to the other. Ammons (2) has reviewed the literature on this topic which reveals the consistency of this phenomenon in demonstrating that the training of one limb transfers to the untrained. Investigators have found this effect associated with a variety of tasks including skills (11), strength of knee extensor (10), pursuit rotor (1), and juggling (17). Consequently, an investigation of the effect of bilateral transfer on C/A should contribute to a better understanding of the acquisition of motor skills which include a C/A component. Therefore, it was the purpose of this study to determine whether subjects' performance of a simple C/A task employing his preferred foot was facilitated by bilateral transfer of practice utilizing his non-preferred foot.

Apparatus

(4) The apparatus employed in this experiment consisted of a 16-foot wooden runway the length of which traveled a small wooden box car.

(5) The runway consisted of a shute and track constructed of 1" x 6" pine with a wooden mono-rail (7/16" x 1½" lath) attached to the center and traversing the length of the runway. The runway sat flat on the carpeted floor of the laboratory. The shute consisted of the initial four feet and was inclined upward 30 degrees from the horizontal. The shute was braced with an L-shaped brace of 1" x 2" pine attached to the top end of the shute and the runway at the shute runway intersection.

(6) The car. The car was 7½" x 1¼" x 4" with ball bearing roller skate wheels. Extending from the side of the car was a 2½" by 3/8" bolt which tripped

both toggle switches as the car passed. Projecting from and above the car, was a 1/8" diameter steel rod 8 inches long, to which a 2 3/4" in diameter styrofoam ball was attached to the end.

(7) Subject Switch. Subject switch was attached to an 18" by $8\frac{1}{2}$" x 3/4" wooden base. A thin rubber pad was glued to the bottom of the base to prevent slippage. The switch was a 6" by 1 3/4" hasp secured to the base and in the reverse position. The two contact points were bolts, one attached to the hasp and the other to the base. To each was connected a lead wire. Depression of the switch allowed the circuit to be completed. A small spring positioned below and in the center of the hasp ensured the circuit breakage whenever a subject released the hasp. At the proximal end, a heavy rubber pad limited the downward movement of the switch. The switch was easily depressed with the foot.

(8) Task. Subjects were required to release the switch so that their release coincided with the instant the front edge of the ball and the front edge of the stationary flag were tangent.

(9) Reliability. Adjacent trail correlations were established for the apparatus and the resulting consistency was $r = .973$.

Procedure

(10) Upon reporting to the laboratory S's were randomly assigned to either the transfer or control group.

(11) Each S was shown the apparatus and instructed as to how it worked. S's were then instructed as to what was required of them. S's were seated in a straight back chair 15 feet from the coincidence flag and perpendicular to it.

The Ss' anticipation switch was placed at their feet so that it was in a comfortable position.

(12) The required S performance was reviewed with the S and all questions pertinent to the performance were answered. Questions pertaining to the nature of the experiment were deferred until after the testing session was complete. When the experimenter and the S were satisfied that the procedure was understood, testing was begun. Each trial was preceded by the experimenter saying "Ready" and the subject's affirmative reply.

(13) Subjects in the transfer group had five trials employing their preferred foot followed by 25 practice trials using their non-preferred foot; following this practice five trials using their preferred foot were administered. The control group was initially given five trials employing their preferred foot. Following these trials the S read an article from the periodical Quest for ten minutes. Following the reading five more trials on the preferred foot were administered.

(14) Subjects. The subjects used in this study were undergraduate student volunteers enrolled at the University of Wyoming during the fall semester 1975. All subjects were right-handed and averaged 20.2 years in age.

Results

(15) The mean and standard deviation for pre- and post-performance of the transfer and control groups for absolute error are presented in Table I and for directional error in Table II.

(16) The effect of bilateral transfer was investigated employing a 2 x 2 analysis of variance with repeated measures on the last factor. Summaries

of these analyses for absolute and directional error appear as Tables III and IV, respectively.

(17) These analyses indicate that within subject's measure was significant for both the absolute and directional error. That is, a comparison of pre- and post-practice was significant at the .05 level. The absolute error analysis also revealed a significant interaction for treatment (transfer-control) and measurement (pre- and post-practice). Testing for simple effects as suggested by Kirk (8) indicated that while the experimental group exhibited a significant difference between pre- and post-performance, the control group did not. Thus, the resulting significant F ratio for measure was the product of pooling both experimental and control variance.

(18) The effect of bilateral reminiscence was investigated for the experimental group by comparing the mean of the first five trials using the right foot with the mean of the first five trials employing the left. The resulting $t = 6.42$ for absolute and 5.732 for directional error were both significant at the .05 level.

(19) Comparison of the final five trials using the left foot to the final five trials employing the right foot for subjects in the experimental group was also made to determine if bilateral reminiscence was present in the latter stages of practice. The resulting $t = -3.56$ was significant at the .05 level, indicating that following practice with the non-preferred foot subjects exhibited a decrease in performance proficiency.

Discussion

(20) The results of this study would seem to indicate that supplementary practice using the non-preferred foot is significantly beneficial to C/A performance

of the preferred foot. This finding is in agreement with a majority of the studies of bilateral transfer and supports the general consensus that performance of the non-practice appendage is enhanced by practice of the opposite appendage. The results reported as directional error indicate that subjects were responding early--before the actual moment of coincidence. While this is consistent with the findings of Stadulis (16), it is not in complete agreement with previous results obtained by the author (6) where one-third of the subjects recorded late responses. Why response tendencies were not more normally distributed is of interest but unexplained.

(21) That the significant interaction for treatment x measure was observed for absolute error and not directional would seem to be a manifestation of a balancing or cancelling out of observed negative and positive differences.

(22) The indicated presence of bilateral reminiscence is in agreement with the findings of Walker, et al. (18) and suggests that the tasks have some similarity so as not to inhibit initial performance improvement. However, the comparison of the experimental group's final left foot practice trials with the final right foot trials which revealed a significant loss in performance proficiency would seem to indicate that the tasks were somewhat in conflict. The lack of bilateral facilitation in the latter phase of practice might reflect interference to performance, whereas the bilateral reminiscence evident in early practice could be a manifestation of becoming acquainted with the novel task and the result of extended practice. Previous studies, Stadulis (16), Dunham (5) and Glad and Dunham (6) have found C/A performance improvement occuring very early in practice and have attributed this improvement to "getting the idea of the task."

(23) It is unfortunate that a control group practicing continually with the right foot was not included in the experiment. This would have permitted a comparison to determine the effect of early practice.

TABLE I

MEAN AND SD OF C/A PERFORMANCE OF TRANSFER AND CONTROL GROUPS (ABSOLUTE ERROR)

	PRE $\bar{X}$	TEST SD	POST $\bar{X}$	TEST SD
TRANSFER GROUP	41.67	22.36	21.87	9.32
CONTROL GROUP	37.97	24.35	29.60	23.70

TABLE II

MEAN AND SD OF C/A PERFORMANCE OF TRANSFER AND CONTROL GROUPS (DIRECTIONAL ERROR)

	PRE $\bar{X}$	TEST SD	POST $\bar{X}$	TEST SD
TRANSFER GROUP	-34.13	26.99	-6.93	12.73
CONTROL GROUP	-29.67	29.85	-9.97	24.36

TABLE III

SUMMARY OF ANALYSIS OF VARIANCE FOR COINCIDENCE-ANTICIPATION PERFORMANCE OF TWO GROUPS (ABSOLUTE ERROR)

VARIATION SOURCE	df	SS	MS	F
BETWEEN SUBJECTS				
TREATMENT	1	122	122	.22
SUBJECTS	58	32,009.92	551.9	---
WITHIN SUBJECTS				
MEASURE	1	5,950.2	5,950.2	259.04[a]
TREATMENT x MEASURE	1	1,349.42	1,349.42	58.75[a]
MEASURE x SUBJECT (Within Treatment)	58	12,932.38	222.97	---
TOTAL	119			

[a] Significant at the .05 level.

TABLE IV

SUMMARY OF ANALYSIS OF VARIANCE FOR COINCIDENCE-ANTICIPATION PERFORMANCE OF TWO GROUPS (DIRECTIONAL ERROR)

VARIATION SOURCE	df	SS	MS	F
BETWEEN SUBJECTS				
TREATMENT	1	15.41	15.41	.02
SUBJECTS (Within)	58	47,799.92	824.13	---
WITHIN SUBJECTS				
MEASURE	1	16,481.67	16,481.67	40.81 [a]
TREATMENT x MEASURE	1	260.58	260.58	.64
MEASUREMENT x SUBJECT (Within Treatment)	58	23,423.75	403.85	---
TOTAL	119			

[a] Significant at the .05 level.

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